

Appln. No. 10/687,022
Amdt. dated January 26, 2006

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-65. (Canceled)

66. (Currently Amended) A process for the production of hydrocarbons from synthesis gas comprising

converting a mixture of hydrogen and carbon monoxide to a product stream comprising hydrocarbons in a reactor comprising a hydrocarbon synthesis catalyst,

wherein the hydrocarbon synthesis catalyst comprises

a catalytically active metal selected from the group consisting of cobalt, ruthenium, iron, nickel, and combinations thereof;

optionally, a promoter; and

a stabilized support prepared by a method comprising drying and calcining a mixture containing a boehmite material and a structural stabilizer or containing a compound of a structural stabilizer and a boehmite material at a calcination temperature between about 500 °C and about 900 °C to form the stabilized support with improved hydrothermal stability.

wherein the structural stabilizer comprises at least one element selected from the group consisting of tungsten (W), tantalum (Ta), niobium (Nb), thorium (Th), germanium (Ge), uranium (U), tin (Sn), antimony (Sb), vanadium (V), hafnium (Hf), sodium (Na), boron (B), magnesium (Mg), aluminum (Al), silicon (Si), calcium (Ca), titanium (Ti), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), strontium (Sr), zirconium (Zr), thorium (Th), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), oxides thereof, and combinations thereof.

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67. (Canceled).

- 2 ~~68~~¹. (Currently amended) The process according to claim ~~66~~¹ wherein the structural stabilizer ~~is~~ comprises at least one element selected from the group consisting of cobalt, magnesium, zirconium, boron, ~~barium~~, silicon, ~~lanthanum~~, oxides thereof, and any combination thereof.
- 3 ~~69~~¹. (Original) The process according to claim ~~66~~¹ wherein the structural stabilizer includes a co-precipitated silica-alumina.
- 4 ~~70~~³. (Original) The process according to claim ~~69~~³ wherein the co-precipitated silica-alumina has a molar ratio of silica to alumina between about 1:1 and about 500:1.
- 5 ~~71~~¹. (Original) The process according to claim ~~66~~¹ wherein the stabilized support is in the form of particles.
- 6 ~~72~~⁵. (Original) The process according to claim ~~71~~⁵ wherein the reactor is a slurry bed reactor or fluidized bed reactor, and the stabilized support has a range of particles sizes between about 10 microns and about 200 microns.
- 7 ~~73~~⁵. (Original) The process according to claim ~~71~~⁵ wherein the reactor is a fixed bed reactor, and the stabilized support has a range of particles sizes greater than 0.5 mm.
- 8 ~~74~~⁵. (Original) The process according to claim ~~71~~⁵ wherein the stabilized support has an average size of the particles between about 50 microns and about 90 microns.
- 9 ~~75~~⁵. (Original) The process according to claim ~~71~~⁵ wherein the particles include a plurality of crystallites with an average size between about 10 nm and about 40 nm.
- 10 ~~76~~¹. (Original) The process according to claim ~~66~~¹ wherein the catalytically active metal is cobalt.
- 11 ~~77~~¹⁰. (Original) The process according to claim ~~76~~¹⁰ wherein the promoter comprises rhenium, ruthenium, platinum, palladium, boron, silver, or combinations thereof.

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- 12 ~~78~~¹ (Original) The process according to claim ~~66~~¹ wherein the mixture has a pH between about 4 and about 6.
- 13 ~~79~~¹ (Original) The process according to claim ~~66~~¹ wherein drying is performed in a spray drier or in a conventional oven.
- 14 ~~80~~¹ (Original) The process according to claim ~~66~~¹ wherein drying is performed at a temperature between about 75 °C and about 200 °C.
81. (Canceled)
- 15 ~~82~~¹ (Original) The process according to claim ~~66~~¹ wherein calcining is accomplished at a temperature between about 500 °C and about 800 °C.
- 16 ~~83~~¹ (Original) The process according to claim ~~66~~¹ wherein the reactor is a Fischer-Tropsch reactor operated at a temperature from about 190°C to about 260°C, and a pressure between about 552 kPa and about 6,895 kPa.
- 17 ~~84~~¹ (Original) The process according to claim ~~66~~¹ wherein the product stream comprises hydrocarbons having 5 or more carbon atoms.
- 18 ~~85~~¹ (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is in the form of a powder.
- 19 ~~86~~¹ (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is spray-dried boehmite.
- 20 ~~87~~¹⁹ (Previously presented) The process according to claim ~~86~~¹⁹ wherein the spray-dried boehmite has a particle size range of from about 20 microns to about 200 microns.
- 21 ~~88~~¹ (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is extruded boehmite.
- 22 ~~89~~¹ (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is dispersible in water or in an aqueous solution.

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- 23 ~~90~~. (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is dispersible in acid or an acidic solution.
- 24 ~~91~~. (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is non-dispersible in water or in an aqueous solution.
- 25 ~~92~~. (Previously presented) The process according to claim ~~66~~¹ wherein the boehmite material is synthetic boehmite.
- 26 ~~93~~. (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has an average pore size larger than about 4 nm.
- 27 ~~94~~. (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has an average pore size between about 4 nm and about 20 nm.
- 28 ~~95~~. (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has a surface area larger than 30 m² per gram of support.
- 29 ~~96~~. (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has a surface area between about 50 m² per gram of support and about 250 m² per gram of support.
- 30 ~~97~~. (Previously presented) The process according to claim ~~71~~⁵ wherein the stabilized support has an average particle size between about 50 microns and about 90 microns.
- 31 ~~98~~. (Previously presented) The process according to claim ~~71~~⁵ wherein the particles have sizes greater than 0.5 millimeter.
- 32 ~~99~~. (Currently amended) The process according to claim ~~67~~¹ ~~66~~ wherein the structural stabilizer comprises at least one element selected from the group consisting of cobalt, magnesium, zirconium, boron, aluminum, ~~barium~~, silicon, ~~lanthanum~~, oxides thereof, and any combination thereof.

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- 33 ~~100~~. (Previously presented) The process according to claim ~~66~~¹ wherein the mixture has a total mixture weight, and wherein the mixture has a solid content of from about 20% to about 60% by weight of the total mixture weight.
- 34 ~~101~~. (Previously presented) The process according to claim ~~100~~³³ wherein the solid content is from about 20% to about 40% by weight of the total mixture weight.
- 35 ~~102~~. (Previously presented) The process according to claim ~~66~~¹ wherein the mixture is a slurry.
- 36 ~~103~~. (Previously presented) The process according to claim ~~102~~³⁵ wherein the slurry comprises boehmite in the form of a powder.
- 37 ~~104~~. (Previously presented) The process according to claim ~~103~~³⁶ wherein the particle size range in the powder is adjusted to a desirable range.
- 38 ~~105~~. (Previously presented) The process according to claim ~~66~~¹ wherein the method for preparing the stabilized support further comprises pre-treating the boehmite material, wherein the pre-treating step includes spray-drying a suspension of the boehmite material, preheating of the boehmite material, or combination thereof.
- 39 ~~106~~. (Previously presented) The process according to claim ~~105~~³⁸ wherein the pre-treating step includes spray-drying the suspension of the boehmite material and then preheating.
- 40 ~~107~~. (Previously presented) The process according to claim ~~105~~³⁸ wherein the preheating step comprises calcining the boehmite material in an oxidizing atmosphere to a temperature ranging from about 250 °C to about 350 °C.
- 41 ~~108~~. (Previously presented) The process according to claim ~~105~~³⁸ wherein the preheating step provides a substantially non-dispersible boehmite.
- 42 ~~109~~. (Previously presented) The process according to claim ~~66~~¹ wherein the mixture is a sol.
- 43 ~~110~~. (Previously presented) The process according to claim ~~66~~¹ wherein the mixture comprises water.

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44 ~~111~~. (Previously presented) The process according to claim ~~110~~ wherein the mixture has a pH below about 7.

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45 ~~112~~. (Previously presented) The process according to claim ~~110~~ wherein the mixture has a pH between about 3 and about 7.

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46 ~~113~~. (Previously presented) The process according to claim ~~110~~ wherein the mixture has a pH between about 4 and about 6.

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47 ~~114~~. (Currently amended) The process according to claim ~~110~~ wherein the method for preparing the ~~stabilized~~-stabilized support further comprises adjusting the pH of the mixture to a pH value between about 4 and about 6 after forming the mixture.

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48 ~~115~~. (Previously presented) The process according to claim ~~114~~ wherein the pH of the mixture is adjusted by adding acetic acid, nitric acid, formic acid, boric acid, or combinations thereof.

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49 ~~116~~. (Previously presented) The process according to claim ~~66~~ wherein the mixture comprises an organic solvent.

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50 ~~117~~. (Previously presented) The process according to claim ~~116~~ wherein the organic solvent comprises methanol, acetone, or ethanol.

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51 ~~118~~. (Previously presented) The process according to claim ~~66~~ wherein the drying is performed by spray drying.

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52 ~~119~~. (Currently amended) The process according to claim ~~66~~ wherein the drying step is performed by conventional drying.

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53 ~~120~~. (Currently amended) The process according to claim ~~119~~ wherein the drying step is performed at a temperature between about 75 °C and about 200 °C.

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54 ~~121~~. (Currently amended) The process according to claim ~~66~~ wherein the calcining step is performed in an oxidizing atmosphere.

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55 ~~122.~~ (Currently amended) The process according to claim ~~66~~¹ wherein the calcining step is performed at a temperature ~~between about 300 °C and about 900 °C~~¹ between 725 °C and 750 °C.

56 ~~123.~~ (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has an enhanced hydrothermal stability and the method for preparing the stabilized support with enhanced hydrothermal stability comprises:

a) forming the mixture by mixing the boehmite material and a compound of at least one structural stabilizer;

b) drying the mixture to form a dried mixture, wherein the dried mixture comprises the boehmite material and the compound of the at least one structural stabilizer; and

c) calcining the dried mixture to form the stabilized support.

57 ~~124.~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein the compound of the at least one structural stabilizer includes a salt of the at least one structural stabilizer, an acid of the at least one structural stabilizer, an oxide of the at least one structural stabilizer, or combinations thereof.

58 ~~125.~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein forming the mixture of step a) further comprises dispersing the boehmite material in a solvent to form a sol and adding the compound of the at least one structural stabilizer to the sol.

59 ~~126.~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein forming the mixture of step a) further comprises dispersing the compound of the at least one structural stabilizer in a solvent to form a sol and adding the boehmite material to the sol.

60 ~~127.~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein forming the mixture of step a) further comprises dispersing the boehmite material in a first solvent to form a first sol, dispersing the compound of the at least one structural stabilizer in a second solvent to form a second sol or solution, and combining the first sol with the second sol or solution.

61 ~~128.~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein step b) further comprises: (1) treating the dried mixture to form a dried mixture comprising a partially-stabilized support; and (2) applying a portion of the at least one structural stabilizer to the dried mixture

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comprising the partially-stabilized support to form a dried mixture comprising a support precursor, and wherein the dried mixture of step c) comprises the dried mixture comprising the support precursor.

- 62 ~~129~~ (Previously presented) The process according to claim ~~123~~⁵⁶ wherein the method for preparing the catalyst support further comprises d) applying an additional amount of a structural stabilizer to the stabilized support.
- 63 ~~130~~ (Previously presented) The process according to claim ~~129~~⁶² wherein the structural stabilizer applied in step d) is the same as the at least one structural stabilizer used in step a).
- 64 ~~131~~ (Previously presented) The process according to claim ~~129~~⁶² wherein the structural stabilizer applied in step d) is different than the at least one structural stabilizer used in step a).
- 65 ~~132~~ (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support has an enhanced hydrothermal stability, and the method for making the stabilized support with enhanced hydrothermal stability further comprises:
forming the mixture by dispersing the boehmite material in a solvent to form a sol;
drying the sol to form a dried boehmite; and
depositing a compound of a structural stabilizer to the dried boehmite to form the mixture, wherein the mixture comprises boehmite and the compound of the structural stabilizer.
- 66 ~~133~~ (Previously presented) The process according to claim ~~132~~⁶⁵ wherein the sol has a total sol weight, and wherein the sol has a solid content of from about 20% to about 40% by weight of the total sol weight.
- 67 ~~134~~ (Previously presented) The process according to claim ~~132~~⁶⁵ wherein the depositing step is accomplished by impregnation, precipitation, or chemical vapor deposition.
- 68 ~~135~~ (Previously presented) The process according to claim ~~132~~⁶⁵ wherein the depositing step is accomplished by impregnation.

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- 69 ~~136~~. (Previously presented) The process according to claim ~~132~~⁶⁵ wherein the boehmite material is calcined at a temperature between about 250 °C to about 350 °C before depositing the compound of the structural stabilizer.
- 70 ~~137~~. (Previously presented) The process according to claim ~~132~~⁶⁵ wherein the method for preparing the stabilized support with enhanced hydrothermal stability further comprises forming the mixture by mixing a boehmite sol and a gel containing at least one structural stabilizer in the form of an inorganic oxide.
- 71 ~~138~~. (Previously presented) The process according to claim ~~137~~⁷⁰ wherein the gel is formed by precipitating an inorganic oxide or co-precipitating at least two inorganic oxides.
- 72 ~~139~~. (Previously presented) The process according to claim ~~137~~⁷⁰ wherein the gel comprises precipitated alumina, silica, titania, zirconia, magnesia, boria, ceria, thoria, or combinations thereof.
- 73 ~~140~~. (Previously presented) The process according to claim ~~137~~⁷⁰ wherein the gel comprises a co-precipitated silica-alumina gel.
- 74 ~~141~~. (Previously presented) The process according to claim ~~137~~⁷⁰ wherein the at least one structural stabilizer comprises an inorganic oxide selected from the group consisting of silica, alumina, titania, zirconia, magnesia, boria, ceria, thoria, and combinations thereof.
- 75 ~~142~~. (Previously presented) The process according to claim ~~137~~⁷⁰ wherein the at least one structural stabilizer comprises at least two elements, with one element having more acidity than the other or others.
- 76 ~~143~~. (Previously presented) The process according to claim ~~66~~¹ wherein the stabilized support is non-dispersible in water or an aqueous solution which comprises an active metal compound.
- 77 ~~144~~. (New) The process according to claim ~~66~~¹ wherein the stabilized support further includes another structural stabilizer which comprises at least one element selected from the group consisting of tungsten (W), tantalum (Ta), niobium (Nb), thorium (Th), germanium (Ge), uranium (U), tin (Sn), antimony (Sb), vanadium (V), hafnium (Hf), sodium (Na), potassium (K), boron (B),

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magnesium (Mg), aluminum (Al), silicon (Si), calcium (Ca), titanium (Ti), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), strontium (Sr), zirconium (Zr), barium (Ba), thorium (Th), lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), oxides thereof, and combinations thereof.